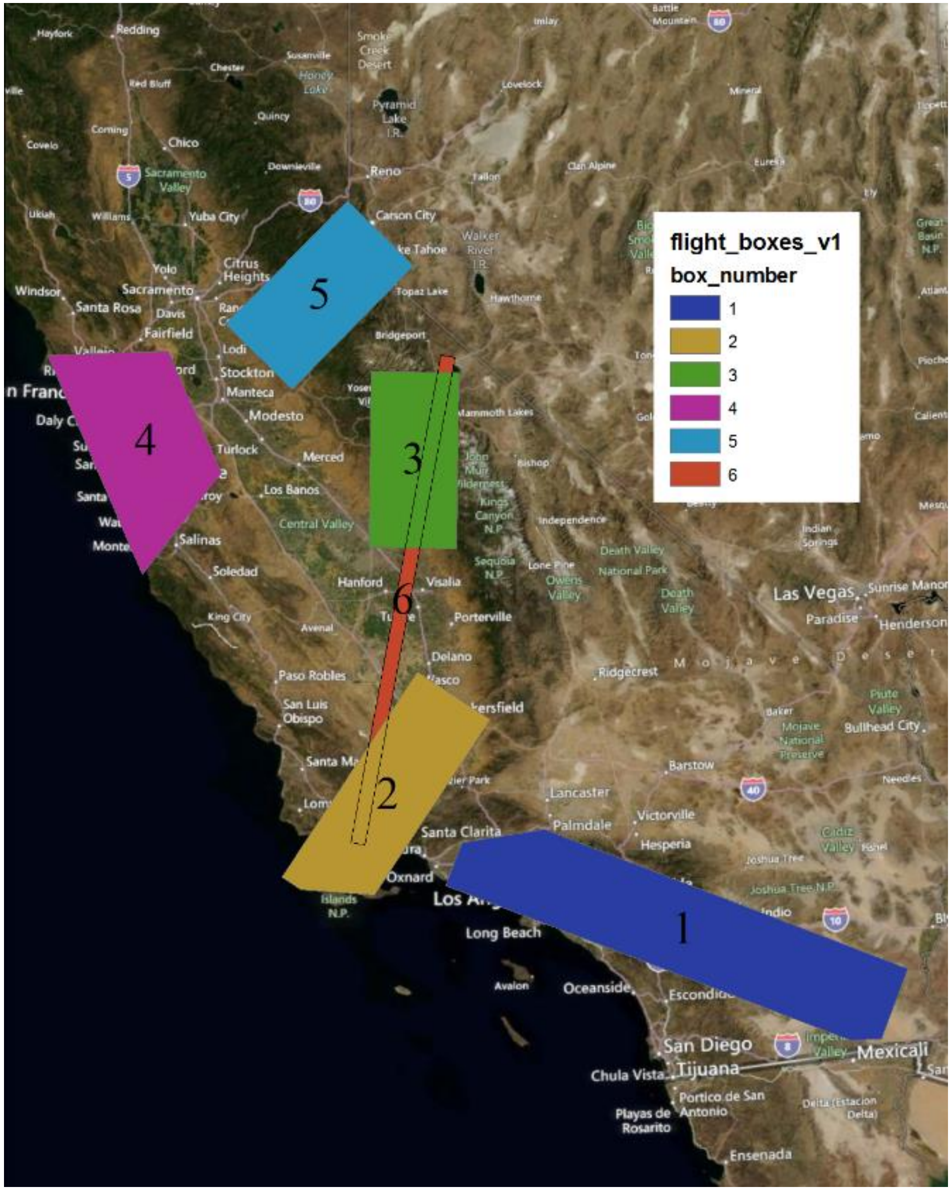
HyspIRI Airborne Campaign Overview

Science Team Meeting
March 17-18, 2014
NASA HQ, Washington, DC

Ian McCubbin, HyspIRI Airborne Mission Manager and the Team

All Blocks Successfully Collected in 2013 plus the RIM Rire



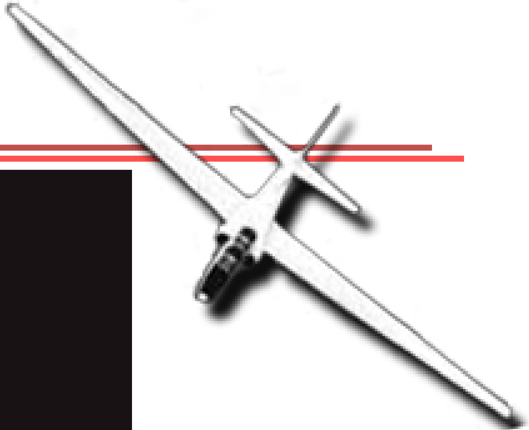
ER-2

HyspIRI Preparatory Airborne Studies

- Harvard/Paul Moorcroft - Linking Terrestrial Biosphere Models with Imaging Spectrometry Measurements of Ecosystem Composition, Structure, and Function
- UC Santa Barbara/Dar Roberts - HyspIRI discrimination of plant species and functional types along a strong environmental-temperature gradient
- UWI/Philip Townsend - Measurement of ecosystem metabolism across climatic and vegetation gradients in California for the 2013-2014 NASA AVIRIS/MASTER airborne campaign
- UC Davis/Susan Ustin - Identification of Plant Functional Types By Characterization of Canopy Chemistry Using an Automated Advanced Canopy Radiative Transfer Model
- Sonoma State/Matthew Clark - Spectral and temporal discrimination of vegetation cover across California with simulated HyspIRI imagery
- NRL/Bo-Cai Gao - Characterization and Atmospheric Corrections to the AVIRIS-Classic and AVIRISng Data to Support the HyspIRI Preparatory Airborne Activities
- USGS/Bernard Hubbard - Using simulated HyspIRI data for soil mineral mapping, relative dating and flood hazard assessment of alluvial fans in the Salton Sea basin, Southern California
- UC Riverside/George Jenerette - Assessing Relationships Between Urban Land Cover, Surface Temperature, and Transpiration Along a Coastal to Desert Climate Gradient
- NEON/Thomas Kampe - Synergistic high-resolution airborne measurements of ecosystem structure and process at NEON sites in California
- UC Santa Cruz/Raphael Kudela - Using HyspIRI at the Land/Sea Interface to Identify Phytoplankton Functional Types
- Bubbleology/Ira Leifer - Hyperspectral imaging spectroscopic investigation of California natural and anthropogenic fossil methane emissions in the short-wave and thermal infrared
- UMD/Shunlin Liang - Characterizing surface energy budget of different surface types under varying climatic conditions from AVIRIS and MASTER data
- RIT/Jan van Aardt - Investigating the impact of spatially-explicit sub-pixel structural variation on the assessment of vegetation structure from HyspIRI data
- UNV/Wendy Calvin - Energy and Mineral Resources: Surface composition mapping that identifies resources and the changes and impacts associated with their development

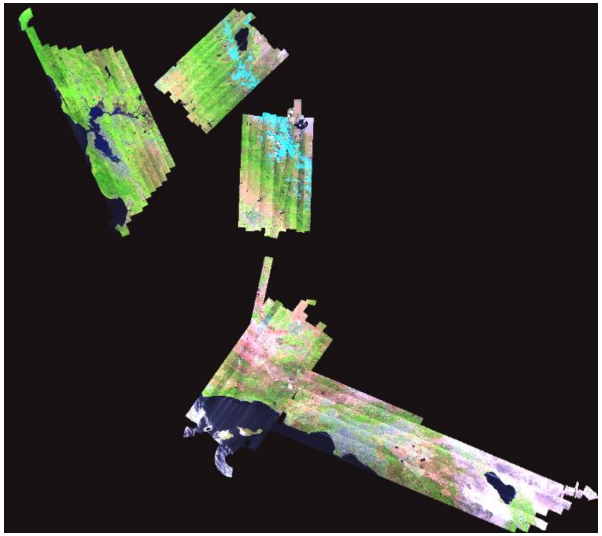
ER-2 HyspIRI 2013 Operations & 2014 Plans

Ian McCubbin, JPL Affiliate & Tim Moes, AFRC



Objectives

Conduct ER-2 Remote Sensing Missions with AVIRIS and MASTER over 6 regions for two years with measurements during Spring, Summer, and Fall.



CY2013 Operations

- All CY2013 planned data was collected
- Station and Rim fire data added to the plan
- 121.8 total HyspIRI flight hours
- Obtained Landsat 8 underpass, Monterrey Bay, and Yosemite/Neon box data through other funded flight requests
- Provided piggyback opportunity for AirMSPI, RSP, NAST-I, NAST-M, S-HIS, and DCS

CY2014 Plans

Flight Request	Study Name	Flight Hours	Principal Investigator
142016	HyspIRI	98.2	Rob Green
142020	Landsat 8	8	Rob Green
142006	ACOCO	14.2	Brian Cairns
142007	Precision Agriculture	9	Darren Drewry

CY2014 Flight Dates:

Mar 31 – May 2
May 27 – June 20
Aug 18 – 29
Sept 15 – Oct 31

Spectral and temporal discrimination of vegetation cover across California with simulated HyspIRI imagery

PI: Dr. Matthew Clark, Sonoma State University, CA

Objective

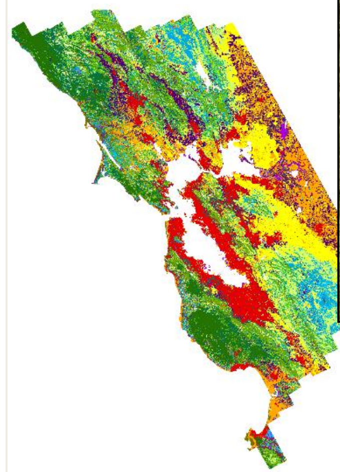
Land cover/use and its change are essential variables needed by the science, policy, and conservation communities

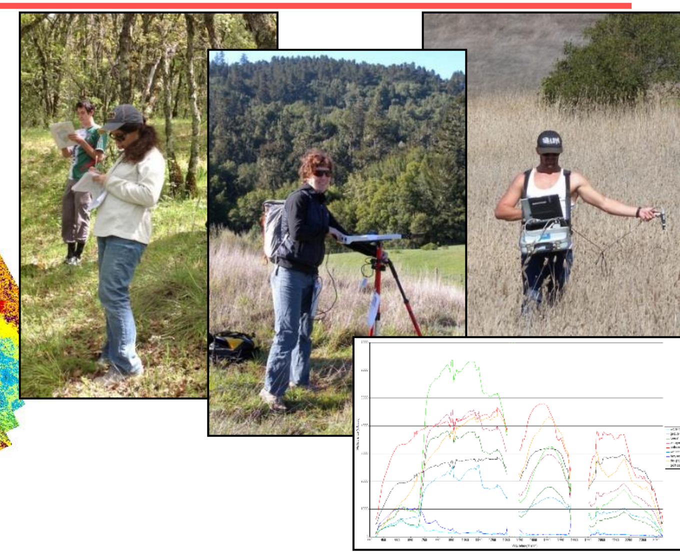
Project assesses multi-temporal, HyspIRI-like data for improved mapping of land cover across a range of environmental and anthropogenic gradients in California

Compare HyspIRI to multispectral Landsat 8 OLI

- class detail, accuracy
- accuracy of change, inter-annual stability

Identify abiotic and biotic controls on spectral-temporal variation among and within natural vegetation types to understand and improve discrimination of classes





Approach:

Map classification scales with 30- & 60-m VSWIR:

1. All boxes: FAO's Land Cover Classification System (LCCS)
2. N. Bay and Yosemite NP: National Veg Classification Standard (NVCS) forest "alliances" (communities)

Classifiers: Random Forests, Support Vector Machine and Multiple-Endmember Spectral Mixture Analysis (MESMA)

Reference data collection:

1. Visual LCCS interpretation of hi-res imagery in web-based tool (VIEW-IT)
2. 60-m diameter plots in North Bay forests include species cover, LAI; for alliance spectral var. analysis

Co-Is: Dr. Nina Kilham, CA Native Plant Society

Progress & Plans:

• Field plots and ASD spectra (North Bay)	2013/2014
• Software development	12/2013
• VIEW-IT land-cover data collection	5/2014
• Land-cover mapping (LCCS)	8/2014
• Forest alliance mapping (NVCS)	2/2015
• Vegetation spectral variation analysis (North Bay)	7/2015

Expected Results:

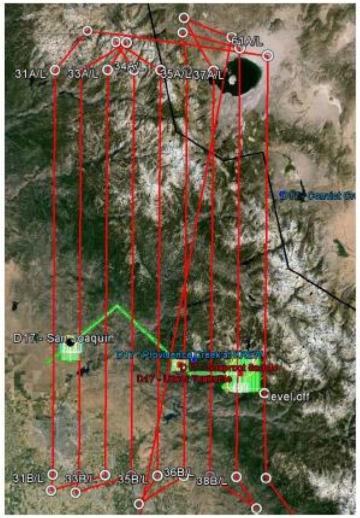
- Multi-temporal, hyperspectral VSWIR data from HyspIRI are fundamental for detailed & accurate land-cover discrimination, especially for forests
- HyspIRI provides more reliable change estimates
- Improved climate and land-change modeling

Synergistic high-resolution airborne measurements of ecosystem structure and process at THE NEON sites in California

PI: Thomas Kampe, NEON, Inc.

Objective

- Acquire high resolution 1-m airborne data and ground measurements to facilitate the development and validation of data products developed at spatial scales anticipated for the HyspIRI VSWIR instrument (60-m)
- Obtain high-resolution airborne data with the NEON Airborne Platform at the NEON sites in California coincident with the “HyspIRI-like” flights
- Acquire a multi-scale data set suitable to address upscaling and down-scaling of ecological data from regional to continental scales
- Demonstrate the suitability of using the NEON infrastructure for HyspIRI calibration and validation, both pre and post-launch



Approach:

- The flights of the NEON AOP over the NEON Pacific Southwest sites were coordinated with HyspIRI-like AVIRIS-classic overflights in central California in June 2013
- NEON flies a remote sensing payload consisting of a high fidelity VSWIR imaging spectrometer, a small-footprint full waveform LiDAR, and a digital camera aboard the NEON Airborne Observation Platform (AOP)
- Field and laboratory data was acquired to support validation of airborne data and support development of higher-level regression algorithms to improve retrievals

CoIs: Nathan Leisso, Keith Krause (NEON); Collaborators included Jan van Aardt (RIT), Crystal Schaaf (U of Mass), Shawn Serbin (U of Wisconsin)

Progress, Plans and Expected Results:

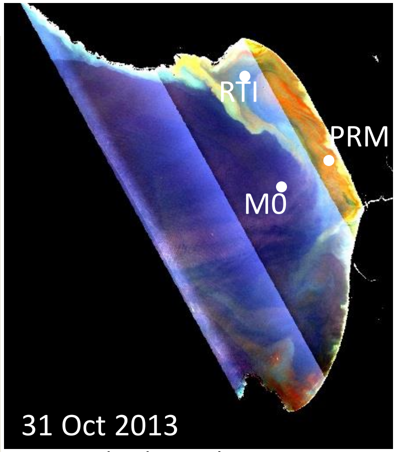
- Overflights of the Pacific Southwest sites were successfully completed in June 2013
- Data has been processed to L-1 (imaging spectrometer: geolocated, calibrated radiance and reflectance; LiDAR: geolocated LiDAR returns; Digital camera: ortho-rectified digital images)
- Data available from aop_data@neoninc.org
- Multi-scale data set being used to support data product development and addressing spatial scaling methodologies at NEON
- Potential for re-flight of NEON Pacific Southwest sites in 2015

Phytoplankton Functional Types and Water Quality at the Land-Sea Interface

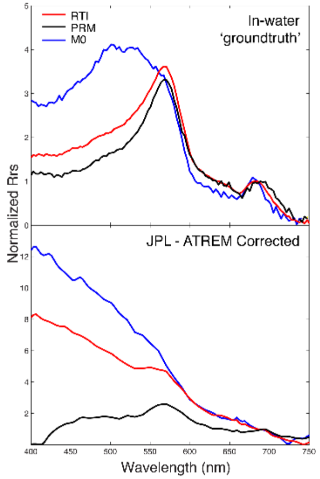
PI: Raphael M. Kudela, University of California – Santa Cruz; Co-PI: Liane Guild, NASA ARC

Objective:

To directly test the capabilities of HyspIRI (using AVIRIS) by providing an end-to-end assessment of image acquisition, atmospheric correction, algorithm application, and ground-truthing to assess whether the satellite sensor can provide adequate signal in the complex aquatic environment of the coastal zone to address questions of algal bloom dynamics, water quality, and transient responses to (e.g.) human disturbance, river runoff, and red tides.



RTI = Red Tide Incubator
PRM = Pajaro River Mouth
MO = Historic MBARI mooring



We need further refinements to atmospheric correction before interpreting PHYDOTax results

PHYDOTax works fine with good data

Approach:

-Ground-truth overflights from boat at 3 stations in Monterey Bay and one station at Pinto Lake.

- Data – chlorophyll, particulate absorption, profile absorption and attenuation (WetLabs ac-S), radiance profiles (Satlantic HyperPro), surface radiance and remote sensing reflectance, Rrs (ASD FieldSpec Pro and GER 1500), optical backscattering (HobiLabs HS2 and HS6)

-Ground-truth 'White Plains' site to improve coastal atmospheric correction

-Atmospheric correction with Tafkaa and work with JPL on their correction with ATREM

-Evaluate phytoplankton functional type algorithm (PHYDOTax) on ground-truth measurements, JPL-corrected imagery, and Ames-corrected imagery

-Evaluate spectral shape algorithms to reduce reliance on atmospheric correction

Progress, Plans and Expected Results:

- Continue to QA/QC ground-truth data, request guidance on preferred format for sharing with community (e.g. SeaBAM)
- Work with B-C Gao to improve atm. correction using ATREM
- Refine our atmospheric correction scheme with Tafkaa
- Continue field collection in 2014
- Explore the use of spectral shape algorithms, particularly using the full spectral range of HyspIRI
  - Relate HyspIRI measurements to water quality
  - Assess improvements to NPP models using HyspIRI-based PFTs and particle size

Co-Is: Sherry Palacios, Kendra Negrey, Jennifer Broughton, and Juan Torres-Perez

HyspIRI for Energy and Mineral Resources

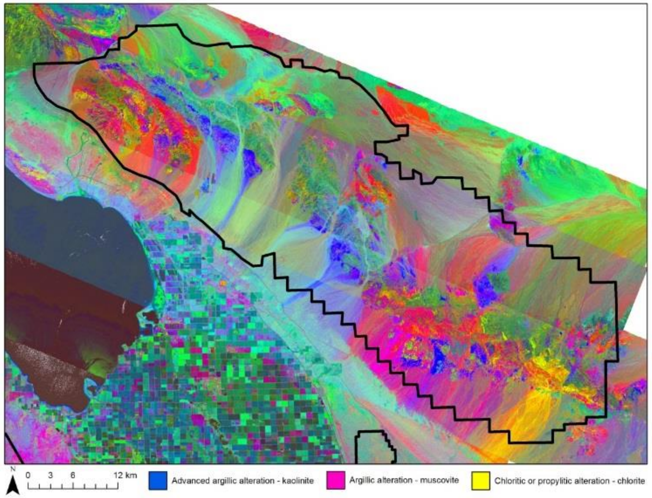
PI: Wendy Calvin, University of Nevada – Reno

Surface composition mapping that identifies resources and the changes and impacts associated with their development.

Objectives:

- Identify new regions for renewable energy development
- Quantify the impacts of renewable energy development
- Reduce reliance on imports of critical minerals
- Quantify the impacts of resource extraction and their evolution over time
- Demonstrate HsypIRI global impact in energy and mineral applications

DCS product discriminates temperature dependent alteration relevant to geothermal energy exploration. 2013 HsypIRI flights over Salton Sea.



Approach:

- Pioneer new methods of automated processing relevant to the energy and mineral sectors.
- Detailed spectral mapping for surface compositions relevant to energy and mineral resources
- Assessment of mapping capabilities at HyspIRI spatial resolution
- Field and lab analysis to validate remote mapping products.

Progress, Plans, Expected Results

- Created new color ratios and classification products for 2013 data over all relevant sites in flight corridors.
- Assessment of mapping capability at all sites.
- Identification of unique spectral features in acid mine waters.
- Characterization of temperature dependent spectral features for energy and mineral exploration.
- Coming year will focus on automated routines, field and lab validation of 2013 and 2014 flights, and HyspIRI spatial resolution mapping.

March/2014 CoIs: E. Littlefield (UNR), 2 MS Candidates

GREAT BASIN CENTER FOR Geothermal Energy

Using simulated HyspIRI data for soil mineral mapping, relative dating and flood hazard assessment of alluvial fans in the Salton Sea basin, Southern California

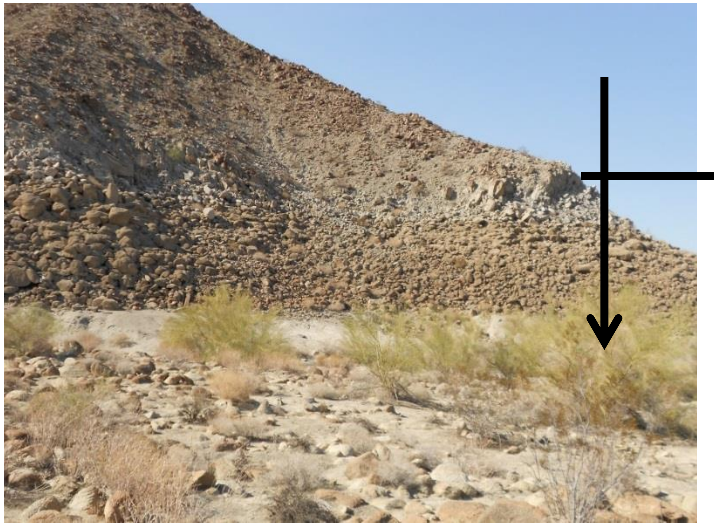
PI: Bernard Hubbard, U.S. Geological Survey

Objective

1) Assess the utility of HyspIRI-like spectral data for relative dating of alluvial fan surfaces indicative of channelized flood and/or debris flow hazards.

2) Determine the spectral characteristics of alluvial channels that will allow us to do "change detection" using HyspIRI-like data, indicative of flooding, erosion and/or deposition of alluvial sediment.

3) Distinguish between weathering and hydrothermal alteration processes in alluvial fans deriving sediment from compositionally varying bedrock source areas (e.g. volcanic bedrock versus crystalline bedrock).



Ancestral Lake Cahuilla (12 masl = 81 m above modern Salton Sea = 69m below sea level)

Approach:

TRL_{in} = 2.5

Salton Sea Basin has had a complex geologic history dominated by fluctuating levels of ancestral pluvial lake Cahuilla in response to climate change. Therefore, the basin contains mixed interaction between alluvial fan, aeolian and lacustrine sediments, the latter which are dominated by gastropod and bivalve shells.

Spectral unmixing methods will be employed in order to map the distribution of key minerals that will allow us to better understand these sediment mixtures, as well as to date upper fan surfaces and accomplish the rest of objectives 1 through 3. For example, desert varnish was found to be an important indicator of age, while aragonite in shells is a key indicator of lake sediments.

CoIs: John Mars (USGS) & Donald Hooper (SwRI)

Progress, Plans and Expected Results:

1) Fieldwork was completed in late August 2013, which included spectral traverses using ASD and samples collected for laboratory analysis. Before and after observations of a major storm was accomplished in first year. In the process, various geologic units were spectrally characterized.

2) Additional fieldwork is scheduled for late April/early May 2014 to visit new training sites and re-evaluate critical previously visited sites (e.g. Martinez Landslide and Alluvial Fans on the Chocolate Mtn side of basin).

3) Two short papers this year. Three more detailed papers next year.

Variation in Urban Microclimate Throughout a Coastal to Desert Gradient

G. Darrel Jenerette, University of California Riverside

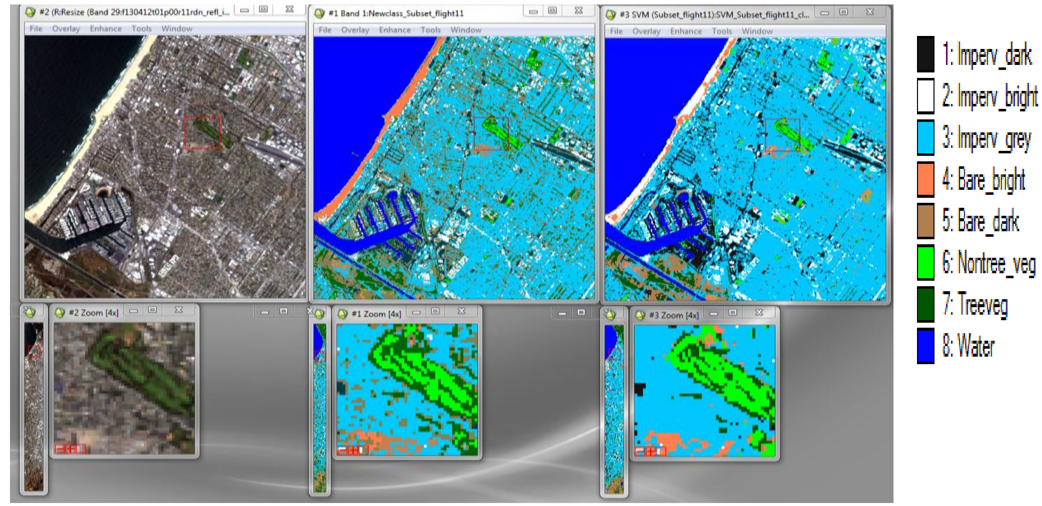
Objective

1. Identify variation in urban heat islands from coastal to desert climate gradient in southern California
2. Assess role of vegetation in altering urban microclimates.
3. Estimate evaporative water demand associated with urban vegetation
4. Evaluate correlations between social segregation and urban vegetation

Approach:

1. Initial evaluation of regional urban-vegetation relationships through analysis of Landsat data.
2. Deployment of three fixed and one mobile eddy-covariance energy balance systems in representative lawns throughout climate gradient.
3. Deployment of a network of 100 air temperature sensors.
4. New classification of AVIRIS data using new "stratified band optimization" approach

CoIs: Gudina Feyisa, Alex Buyantuyev, Steven Crum



True Color

Stratified Band Optimization (20 bands / class)
-Overall Accuracy: 96.9%
Kappa Coefficient: 0.96

Support vector machine (178 bands)
Overall Accuracy: 93.5%
Kappa Coefficient: 0.92

Progress

1. Field data streams are being deployed in conjunction with airborne campaigns.
2. Regional urban classification has been developed suitable for regional scale analysis of imaging spectrometer data

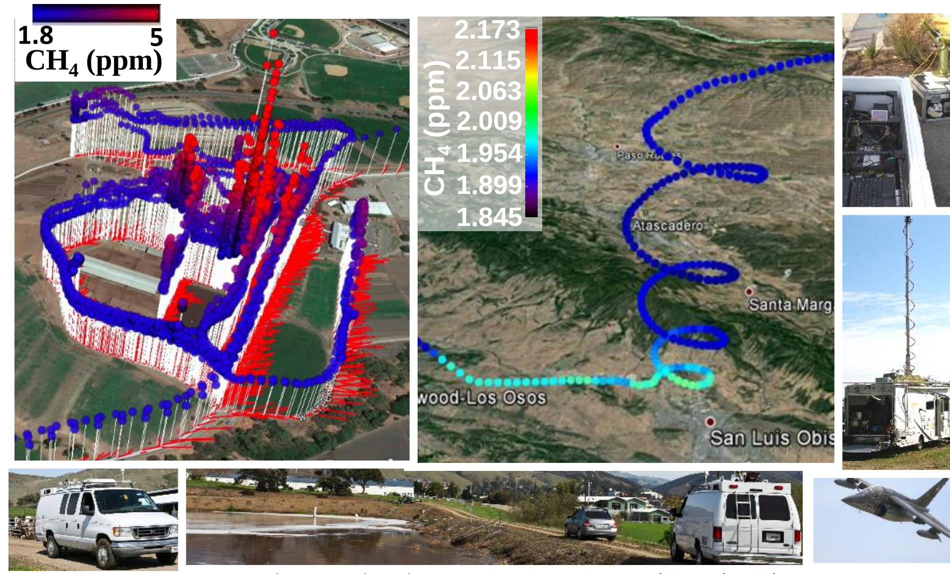
2014 Plans

1. Field measurements will continue or expand leaf trait, microclimate, and energy balance measurements
2. Analyze thermal imagery in relation to land cover and energy balance

COWGAS : A HyspIRI and COMEX PreCursor Activity

PI: Ira Leifer, Bubbleology Research International

Objective: COMEX pre-cursor study demonstrating cal/val by combining surface column measurements, *in situ* surface mobile, and *in situ* airborne data.



A) Surface CH_4 and Winds during COWGAS (BRI), B) Ajax in situ CH_4 300–5000 m (ARC), mini-LHR (GSFC), RAMVAN (AERO).

Approach:

-> Focus on a well-described, isolated, strong source.

-> Collect column CH_4 data thermal (mobile) & fixed-location (SWIR), *in situ* surface mobile & airborne data, and surface & airborne winds and met data.

-> Plume Inversion modeling to infersource strength.

-> Radiative transfer modeling to Twin Otter, ER2, and orbital altitudes of observed plume to characterize detection limits and inform orbital instrumental design parameters.

-> Integrate emissions and dairy operations.

-> Publish.

Progress, Plan, Expected Results:

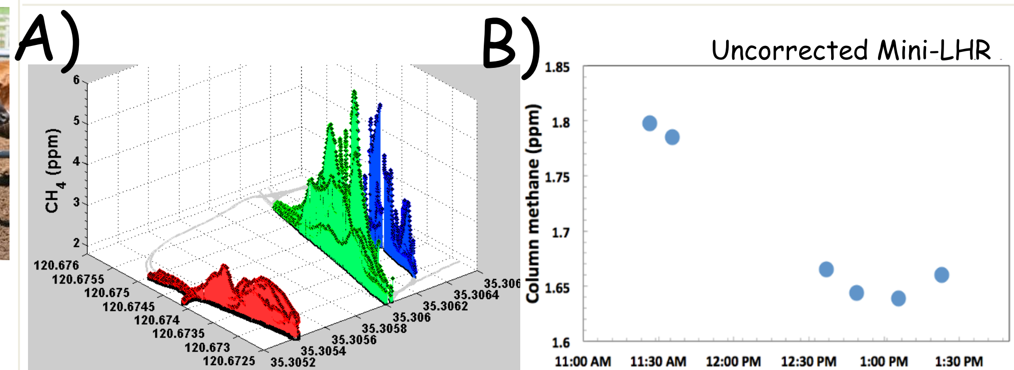
COWGAS campaign formulated Jan. 2014.

Successful data collection 4-6 Mar. 2014.

In Process -> Plume identification and modeling.

In Process -> Trace gas fingerprinting.

In Progress -> Publish (CIP done)!



A) Three transects through a CH_4 plume during COWGAS, which will be inverse plume modeled to derive emission strength. B) *Preliminary* (Cloud Uncorrected, uncalibrated) mini-LHR CH_4 column during COWGAS. AJAX overflight at ~1230 LT.

COWGAS Team: Aerospace Corp., Bubbleology Res. Intnl., Calif. Air Resources Board, California Polytechnic Inst., Los Gatos Research, NASA Ames Res. Cent., NASA Goddard Space Flight Cent., Univ. of Bremen, Univ. of Southern Florida, Lawrence Berkeley National Lab.

Characterizing land surface energy budget under varying climatic conditions from the AVIRIS and MASTER data

PI: Shunlin Liang, University of Maryland

Objectives

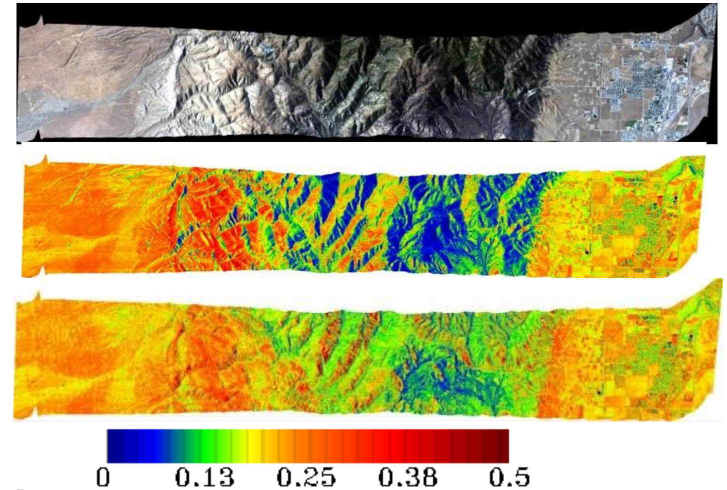
Quantification of the variations in land surface radiation and energy budget over different land cover types in response of climate variability from the AVIRIS and MASTER data to support the development of the HyspIRI mission

- Mapping the surface radiation and energy budget components from both AVIRIS and MASTER data
- Quantifying the variations in surface energy budget of different surface types

True color composite

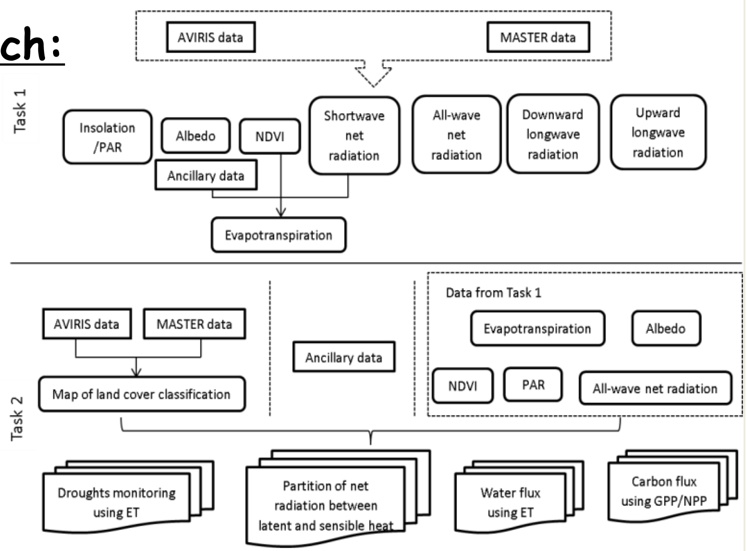
Shortwave albedo before correction

Shortwave albedo after correction



Topographic correction on surface albedo estimation

Approach:



CoI: Dr. Dongdong Wang

Progress, Plans and Expected Results:

- All algorithms for the AVIRIS data have been developed;
    - Unique algorithms for mapping albedo and shortwave net radiation have been developed, relying on spectral information rather than angular information
- Algorithms for the MASTER data are still under development
- Participated in 2013 campaigns;

- All algorithms will be ready and mapping all components
- in Y2; If possible more ground data will be collected

March 2014

Advances in Atmospheric Correction for the HyspIRI Preparatory Campaign

Bo-Cai Gao, Naval Research Laboratory

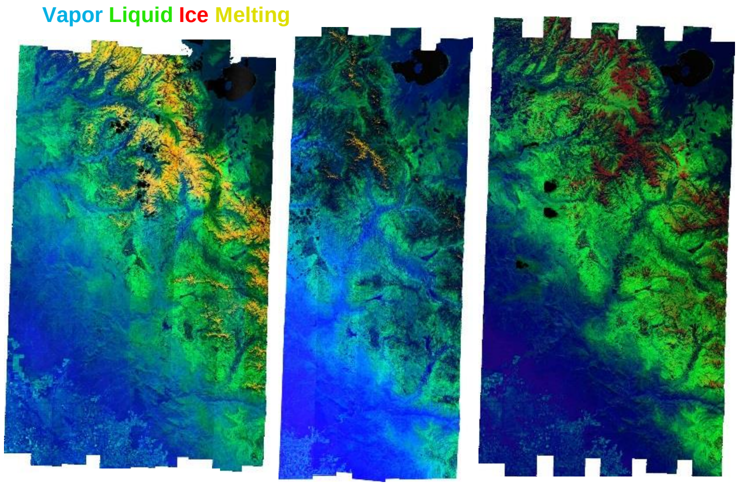
Objective

Atmospheric correction enabling consistent, accurate Level 2 reflectance products

Account for atmospheric and elevation change over large geographic areas, multiple seasons and weather conditions

Reduce known biases caused by surface properties such as vegetation canopy liquid

Provide additional useful data products such as liquid water and ice maps



3 May 2013 26 June 2013 5 November 2013

Simultaneous three-phase estimation of atmospheric and surface water over Yosemite National Park. We map ice, liquid, and vapor optical paths at 18m resolution over an area of 14000km^2. Maps quantify the spring melt and Autumn snowfall.

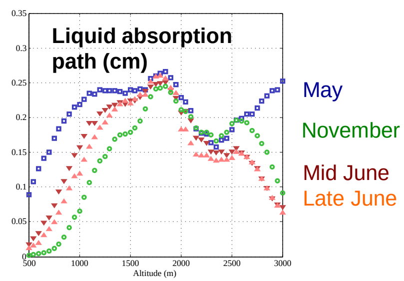
Approach:

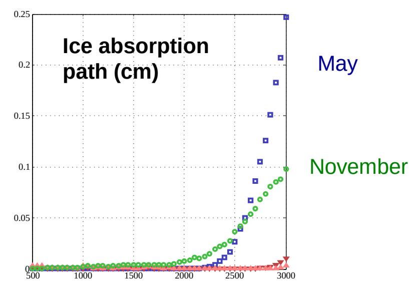
- The ATREM atmospheric correction routine corrects for absorption (based on HITRAN 2012 line database) and scattering (using the 6s radiative transfer code)
- Estimate pressure altitude using the oxygen A band
- Initialize H_2O water vapor using absorption band ratios
- Refine this estimate with a novel log-linear model capturing absorption by vapor, liquid, and ice phases
- A nonnegative linear least squares solver provides a fast, stable solution while respecting physical constraints.

CoIs: **Robert O Green, Sarah Lundeen and David R Thompson,**
Jet Propulsion Laboratory

Results and Plans

- Three phase water maps reveal shifts in water content over large spatiotemporal areas. The right panel shows Yosemite seasonal trends by elevation.
- We will continue validating this product for the 2014 HyspIRI pipeline.
- We will also evaluate errors in HITRAN2012 H2O line data base and solar irradiance curve on surface reflectance retrievals.





Elevation (m)

IDENTIFICATION OF PLANT FUNCTIONAL TYPES BY CHARACTERIZATION OF CANOPY CHEMISTRY

PI: Susan Ustin, University of California, Davis   CoPIs: Alexander Koltanov, UC Davis; Carlos Ramirez, USFS

Keely L. Roth, Maria M. Alsina, Margarita Huesca, Angeles Casas, Spencer Mathews

Objectives

Advance scientific understanding of the relationship between conventional plant functional types (PFT(c)) and physiologically important biochemical components at the canopy scale.

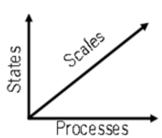
Sub-goal I: Identify whether biochemical compositions match *conventional* PFTs and their groups.

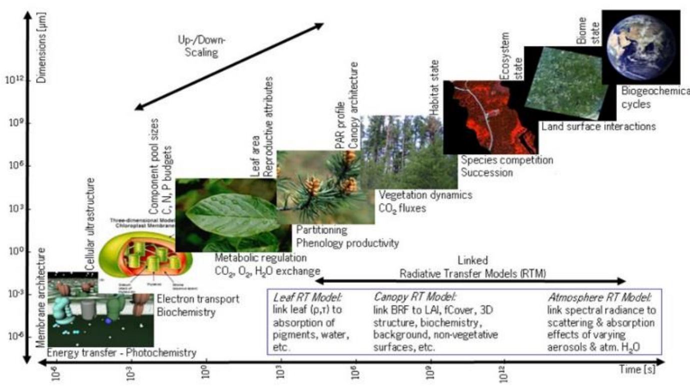
Sub-goal II: Evaluate the clustering of remotely sensed biophysical and biochemical properties in relation to PFTs. To what extent do PFT differences influence retrieved biochemical concentrations?

Sub-goal III: Test the potential for complete automation of the radiative transfer model inversion to retrieve canopy chemistry products from HyspIRI spectra.

Approach:

- Collect leaf biochemistry, leaf spectra and canopy structural data over sites that vary in environmental conditions and PFT & species composition
- Estimate leaf-level biochemistry using empirical models and radiative transfer inversions
- Explore data clusters within leaf & image spectra and leaf biochemistry and compare these to species and conventional PFTs
- Evaluate methods for incorporating canopy structure in biochemistry estimation

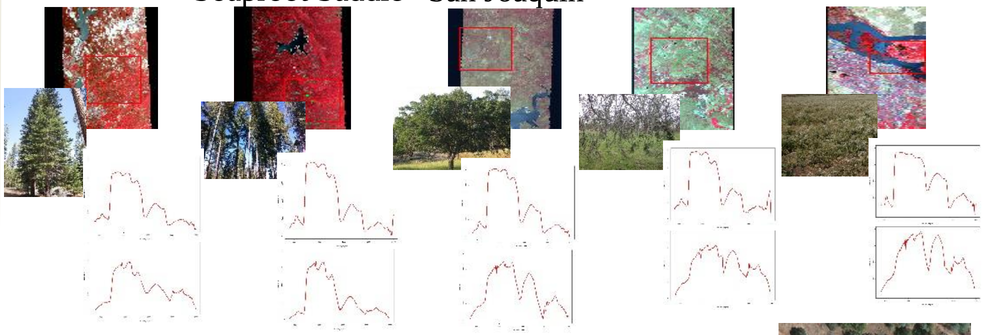


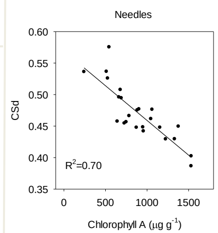


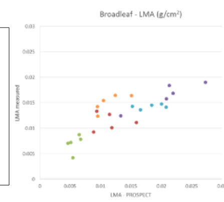
03/14

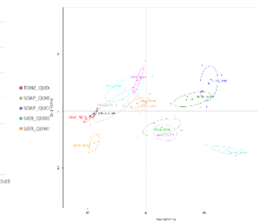
Preliminary Results

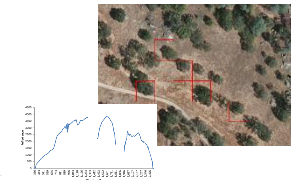
Teakettle   Soaproot Saddle   San Joaquin   Tonzi Ranch   Sherman Island











Wavelength	Correlation LAI	D	CD	H
385-714	**-0.76**	**0.30**	**0.62**	-0.13
733-956	0.22	-0.17	-0.16	0.10
966-1139	-0.18	**-0.26**	0.30	0.08
1148-1343	**-0.65**	-0.12	**0.63**	-0.05
1422-1801	**-0.73**	0.05	**0.70**	-0.12
1946-2446	**-0.71**	0.16	**0.67**	-0.15

- Leaf-level biochemistry predictions are producing acceptable results.
- Leaf spectral clusters generally correspond to PFT(c) and leaf chemistry.
- Canopy structure has a clear influence on the image spectra that must be addressed.

Ongoing Research

- Extend current analysis to include full set of species, sites and dates
- Quantitatively evaluate data clusters & their correspondence to PFT(c)
- Invert canopy radiative transfer models to estimate canopy biochemistry
- Test approaches for incorporating canopy structure in biochemistry retrievals without the use of a secondary sensor

HyspIRI discrimination of plant species and functional types along a strong environmental-temperature gradient

PI: Dar A. Roberts, University of Calif. Santa Barbara

Objectives:

- Plant species and chemistry VSWIR-TIR spectroscopy
- Improved Temperature Emissivity Separation (TES) using VSWIR water vapor
- Species discrimination along a coast-to-interior gradient
- Species composition , cover and Land Surface Temperature (LST)

Approach:

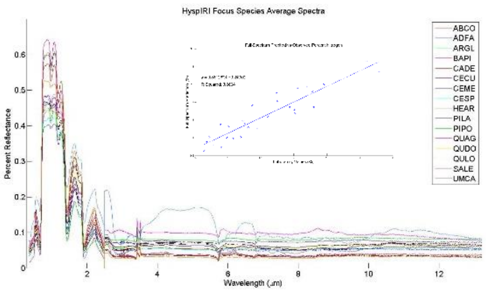
VSWIR-TIR spectroscopy at JPL, PLS regression for biochemicals (e.g. lignin-cellulose, N, water)

AVIRIS water vapor, interpolation over artifacts and to identify regional airmasses, water-vapor constrained TES

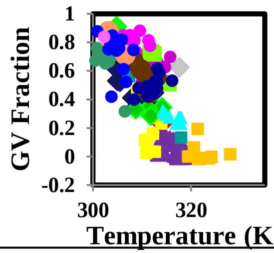
MESMA using regional, local, seasonal and full year libraries

Comparison between plant species, cover and LST seasonally

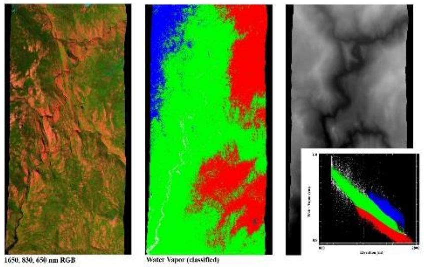
CoIs: Phil Dennison, Univ. Utah, Glynn Hulley, JPL



VSWIR-TIR spectra of 16 dominant shrub/tree species. Predicted vs estimated N from VSWIR-TIR



Plot of GV fraction vs LST, showing unique species clustering



False color composite of central Sierra Nevada (left). Map of three regional airmasses (center) identified from water vapor-elevation relationship (right)

Plans, Progress and Expected Results:

- First VSWIR-TIR spectroscopy, showing correlation with plant biochemistry (esp. VSWIR) for these species
- Vegetation species clustering in GV-LST space, likely due to differences in functional attributes. The pattern should change seasonally with water stress
- VSWIR identification of spatial patterns in water vapor that should improve LST retrievals
- Combined VSWIR water vapor and TIR data identifying regional patterns in ET and water stress unique to HyspIRI

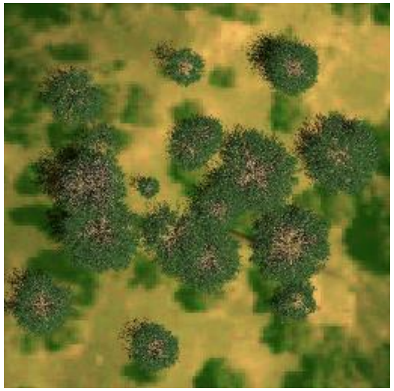
On assessment of vegetation structure from HyspIRI data

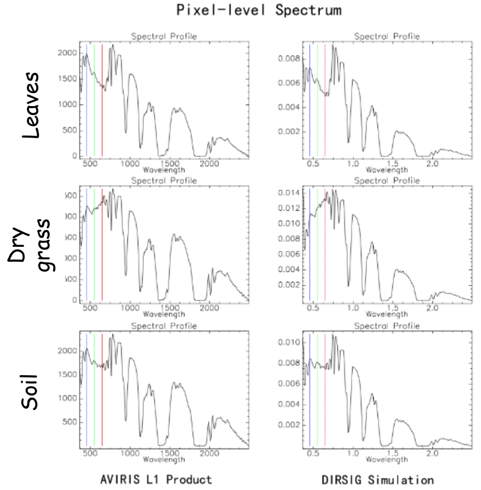
PI: Jan van Aardt, Rochester Institute of Technology

Objectives

- Assess the scalability of selected narrow-band structural vegetation indices (VIs) from 20m AVIRIS to 60m HyspIRI data sets;
- Investigate the utility of a VI derivation approach that includes all possible normalized two-band combinations at the 60m spatial scale;
- Assess how sub-pixel variations in LAI, biomass, canopy height, and other forest inventory variables affect the spectral response on a per-pixel basis; and
- Evaluate how the sub-pixel structural variation interacts with the system's response, most notably in terms of the PSF

Simulating HyspIRI: A virtual oak-savanna scene





Validating simulated AVIRIS data (right) vs. a real AVIRIS scene (left)

Approach:

To assess vegetation structure from HyspIRI data, the following tasks will be completed:

1. Extract VIs from AIVIRIS data and correlate with field measured LAI;
2. Compare results from varying within-pixel structures in terms of spectral response;
3. Use DIRSIG to simulate AVIRIS and HyspIRI data over realistic virtual scenes - verify (1) & (2);
4. Use simulation approach to assess how spatially-explicit structure interacts with system PSF.

CoIs: M. Gartley, RIT
Crystal Schaaf, UMB

Key Milestones

• Field sampling 2013/2014	6/13 & 6/14
• Upscaling of HyspIRI data	1/14
• DIRSIG scene construction	6/14
• Evaluate spectral-structural sub-pixel interactions	
• 2013 field data – upscaled AVIRIS	12/13
• 2014 field & simulation data	12/14
• Simulation-based calibration	3/15
• Extension to field-based calibration	6/15
• Robust pixel-level structural assessment	10/15

TRL_{in} = 2

Linking Terrestrial Biosphere Models with Remote Sensing Measurements of Ecosystem Composition, Structure, & Function

Paul R. Moorcroft[1], Alexander Antonarakis[1,2], Stacy Bogan[1], Glynn Hulley[3]

[1]Harvard University , Sussex University[2], [3]Jet Propulsion Laboratory

Objective:

Examine how imaging spectrometry measurements (from AVIRIS-classic & MASTER and future instruments such as HyspIRI, AVIRIS-ng, & HyTES) can be used to provide accurate, and comprehensive estimates of current above-ground ecosystem state.

Approach:

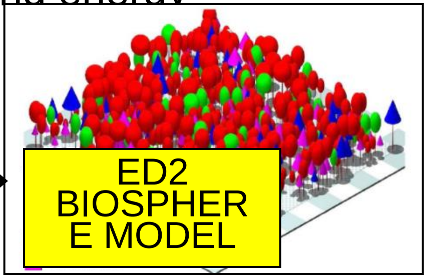
Use measurements from the above instruments to estimate plant functional composition, and canopy and soil temperatures, that can be used to constrain terrestrial biosphere model predictions of the current and future carbon, water and energy fluxes of the land surface.

Hyperspectral Imagery

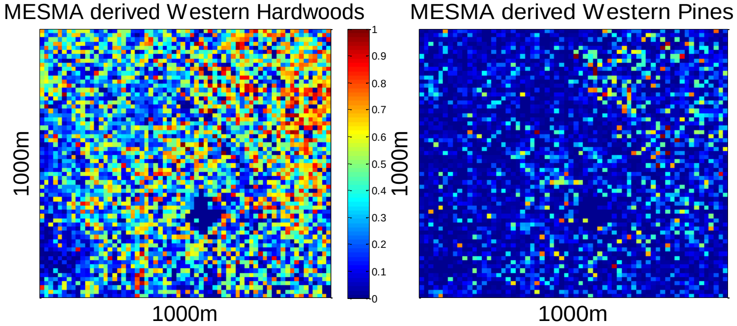
Spectral mixture analysis or leaf chemistry est.

Canopy Composition

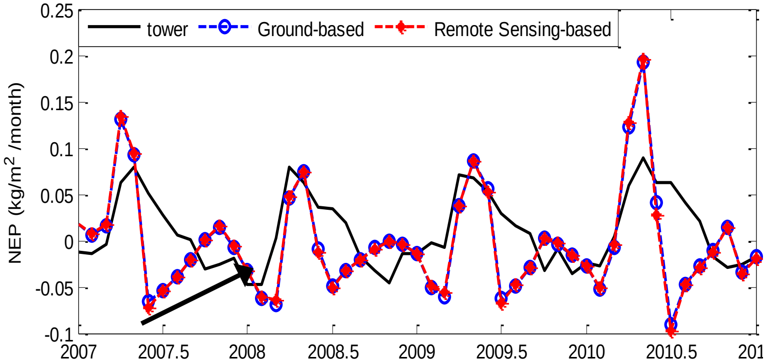
(abundance of different plant functional types)



Imaging Spectrometry derived-estimate of plant composition around the Tonzi Ranch Flux Tower:



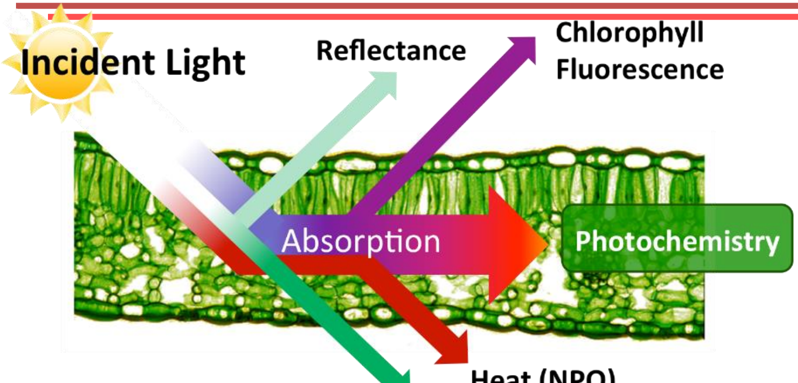
Predicted and Observed Seasonal Patterns of Net Ecosystem Productivity (2006-11):

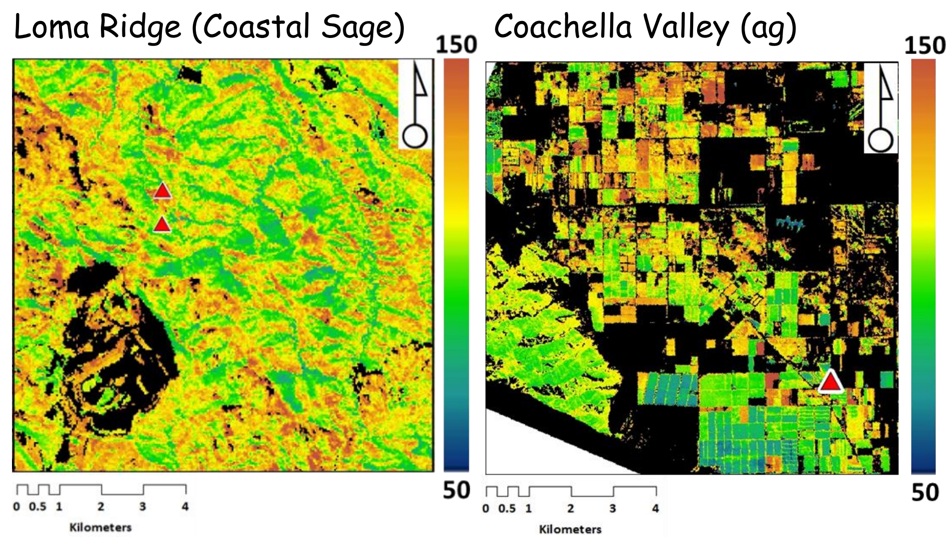


Next Steps: apply this methodology to the HyspIRI preparatory science campaign imagery to produce remote-sensing constrained estimates of regional carbon fluxes.

Imaging spectroscopy of plant physiology

PI: Phil Townsend, University of Wisconsin-Madison





Objective

We proposed to use hyperspectral + thermal IR imagery from HyspIRI to map vegetation photosynthetic (metabolic) capacity.

Approach:

Leaf/Plot Field Photosynthesis → Vcmax Jmax

Vcmax Jmax → Map Metabolic Capacity

HyspIRI HSI+TIR → Map Metabolic Capacity

Eddy Cov. Flux Towers → NEE → ✔ ← Map Metabolic Capacity

CoIs: Shawn Serbin (BNL), Mike Goulden (UCI)
Eric Kruger, Ankur Desai, Sean Dubois (UW)

Progress, Plans and Expected Results:

- Leaf level calibrations complete
- Sampled sites in spring and early summer in 2013 and plan for all 2014 campaigns
- EC tower flux data inversion underway
- Retrievals of foliar traits look good
- Preliminary maps of V_{cmax} corroborate field measurements
- Results provide basis to map key metabolic properties needed for ESMs using HyspIRI

TRL_{in} = 5

Drought Impacts on Vegetation Measured Using Simulated HyspIRI VSWIR Products

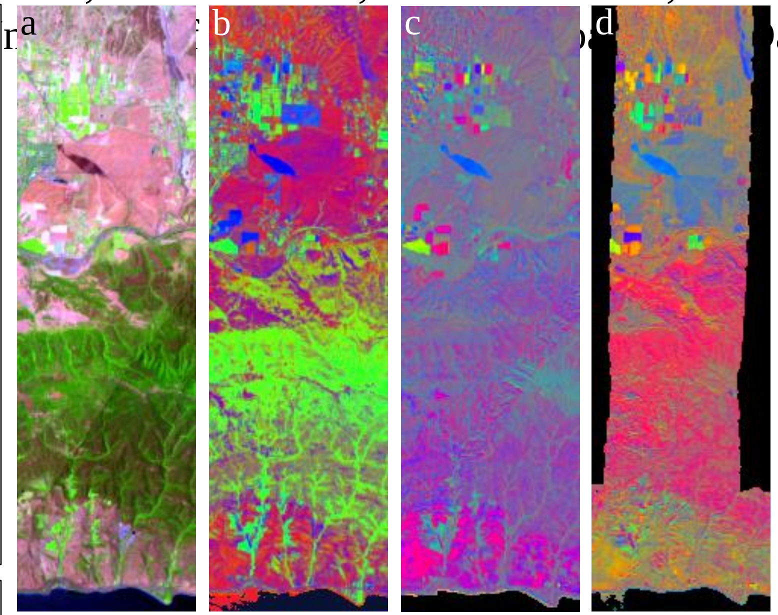
Phil Dennison[1], Dar Roberts[2], Austin Coates[1], and Keely Roth[3]

Objectives

- Determine how drought impacts fractional cover of photosynthetic vegetation, non-photosynthetic vegetation (NPV), and soil in southern California ecosystems
- Examine how changes in vegetation fractional cover and corresponding changes in land surface temperature vary by species

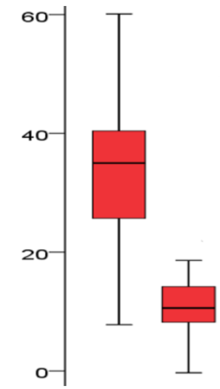
Approach

- HyspIRI VSWIR data can resolve differences between NPV and soil, as well as map dominant vegetation species
- AVIRIS data from July 2011 (wet year) and June 2013 (2nd year of drought) were used to create L2 reflectance products at 60m resolution
- Linear spectral unmixing was used to calculate fractional cover of green vegetation, NPV, soil, and shade



a. June 2013 60m reflectance
b. June 2013 normalized NPV, GV, and soil fractions
c. Apr-Jun 2013 change in fractions
d. Jul ‘11-Jun ‘13 change in fractions

Increase in NPV fraction from Jul 2011 to Jun 2013 for bigpod Ceanothus (left) and Calif. buckwheat (right)



Progress and Expected Results

- Grassland and coastal sage scrub phenology dominate the short term change in fractional cover when comparing April 2013 to June 2013
- Strong increases in NPV fraction were found in chaparral when comparing July 2011 to June 2013
- Increases in NPV fraction were largest for chamise and Ceanothus, both evergreen shrub species; blue oak and buckwheat were less affected
- Further analysis will use 30m data, incorporate species maps from simulated VSWIR data, and include data acquired during 2014 season
- Changes in land surface temperature from MASTER data between 2011, 2013, and 2014 will also be investigated
- We expect to quantify dieback of less drought tolerant shrub and tree species, with effects worsening from 2013 to 2014

MASTER L1/L2 Products

PI: Glynn Hulley/Simon Hook, Jet Propulsion Laboratory

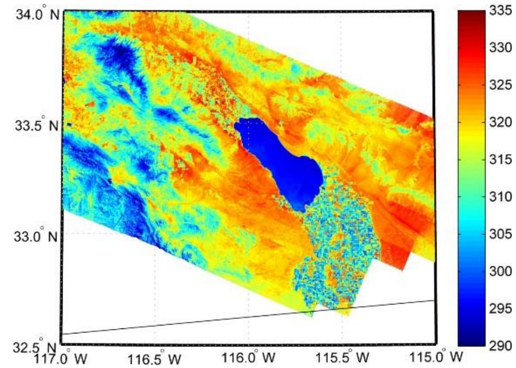
Primary Objectives

- Generate MASTER L2 Surface Temperature and Spectral Emissivity products using MASTER LWIR bands 42-50.
- Distribute the data via online ordering tool (http://masterprojects.jpl.nasa.gov/L2_products)

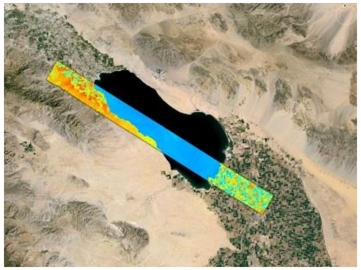
Secondary Objectives

- Calibrate MASTER L1B radiance at sensor using Lake Tahoe and Salton Sea in situ validation data.
- Validate MASTER L2 products using Lake Tahoe and Salton Sea in situ validation data as well as field measurements from pseudo-invariant sand sites.

LST (resampled to HyspIRI TIR 60-m)



KML browse image



Approach:

- MASTER L2 processing uses the Temperature Emissivity Separation Algorithm (TES) with a Water Vapor Scaling (WVS) based atmospheric correction scheme.
- For calibration, in situ measurements are forward modeled with atmospheric profiles to simulate MASTER at-sensor radiances at ~20 km altitude.
- For Validation, MASTER LST are matched with in situ buoy data at Tahoe/Salton Sea. Emissivity spectra are matched with lab measurements of samples collected in the field.

Progress, Plans and Expected Results:

- All 2014 MASTER campaign data have been processed to L2 LST and Emissivity products.
- MASTER L2 data are available for ordering at: (http://masterprojects.jpl.nasa.gov/L2_products)
- Browse images including kml's will be available starting this week.
- More extensive LST and emissivity validation is planned for 2014 campaign data over more diverse set of validation sites.

CoIs: Jeffrey Myers, ARC

HyspIRI Preparatory Airborne Campaign
L1 and L2 Data Product Status

Objective

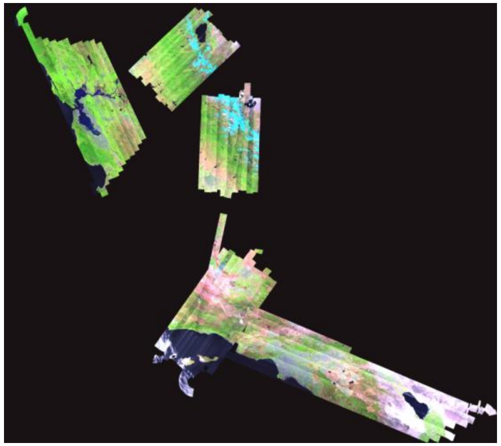
Deliver L1 and L2 products to the Science Team

AVIRIS-C simulating HyspIRI VSWIR

-Deliver radiance with full laboratory spectral, radiometric, and spatial calibration

-Deliver reflectance with HyspIRI like radiative transfer algorithm

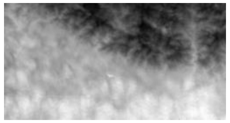
Example Mosaic of AVIRIS-C Products

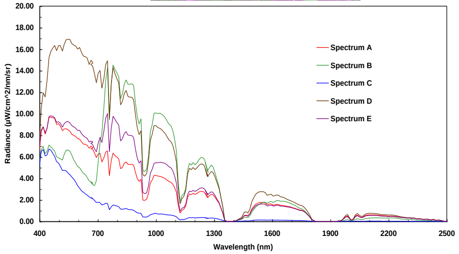


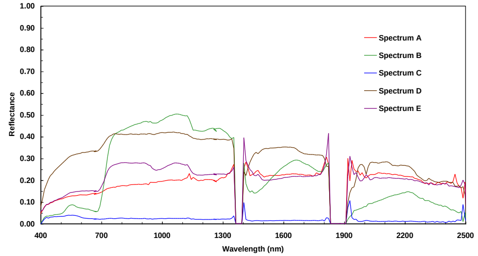
Approach

-Use the latest laboratory calibration methodologies and measurements for accurate L1 calibration of AVIRIS-C

-Use the HyspIRI baseline radiative transfer based atmospheric correction to provide the L2 data to the science team







Progress and Expected Results

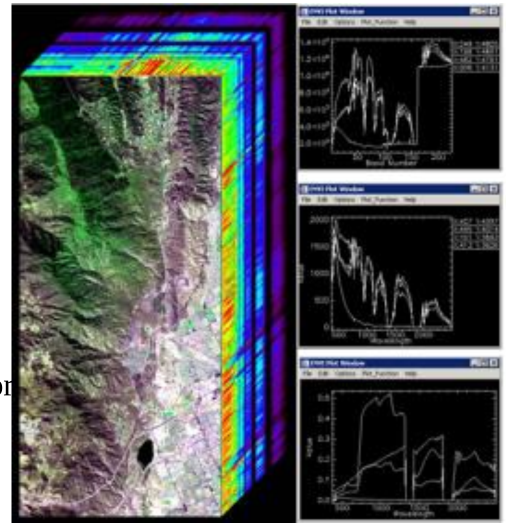
AVIRIS-C simulating HyspIRI VSWIR

-All AVIRIS-C data have been delivered as radiance (L1)

-All AVIRIS-C data have been -delivered as reflectance (L2)

Contributors: The AVIRIS suppor team

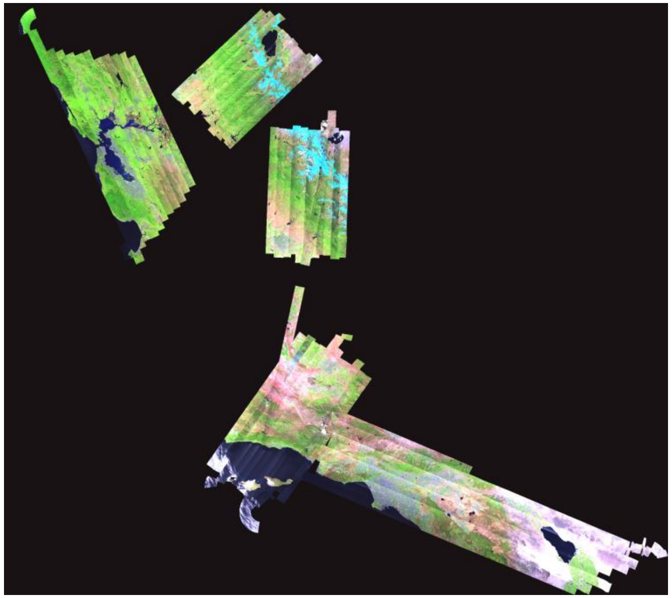
We are ready for 2014



L2 Simulated HyspIRI VSWIR Products

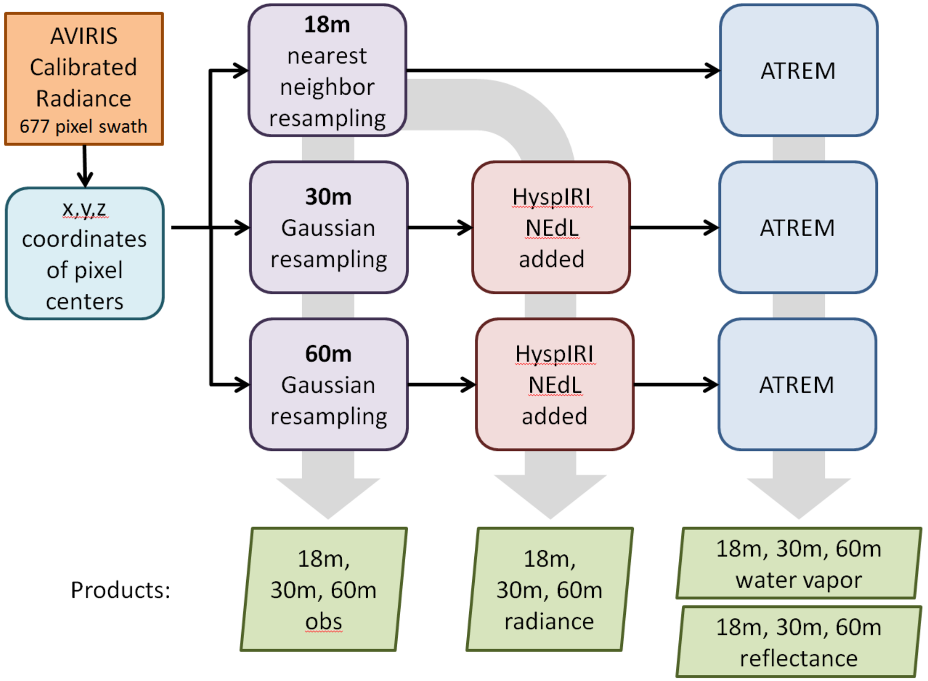
Objective

Create orthorectified reflectance data with similar spatial and noise characteristics to HyspIRI VSWIR for the HyspIRI Preparatory Campaign



Approach

- Ray-traced pixel center coordinates were resampled using a Gaussian point spread function to create 30m and 60m radiance data
- Random noise with a Gaussian distribution was scaled based on NEdL calculated from radiance and VSWIR radiometric model, then added to radiance
- ATREM was used to retrieve reflectance and column water vapor from the noise-added radiance data



Progress and Expected Results

- Orthorectified radiance, reflectance, water vapor, and obs files are available at 18m, 30m, and 60m resolutions http://aviris.jpl.nasa.gov/data/AV_HyspIRI_Prep_Data.html
- 197 flightlines processed by JPL as of Mar 14
- Based on March-April 2013 mosaic, campaign covers more than 130,000 km^2
- Validation needed for orthorectification, reflectance

Contributors

David Thompson, Rob Green (Jet Propulsion Lab)
Phil Dennison (University of Utah)
Bo-Cai Gao (Naval Research Lab)
Joe Boardman (Analytical Imaging and Geophysics)

Name	Role	Name	Role
Bob York	ER-2 Engineering	Kevin Kraft	ER-2 Maintenance - Logistics
Brain Rheingans	AVIRIS Telemetery Engineer	Luis Rios	ER-2 Maintenance - Electrician
Caitlin Barnes	MASTER Engineer	Marco Hernandez	AVIRIS Technician
Carl Sorenson	Avionics Engineer	Mark Helmlinger	AVIRIS Calibration
Charles Sarture	AVIRIS Lead Engineer	Michael Eastwood	AVIRIS Instrument Lead
Chris Miller	ER-2 Project Manager	Michael Kohler	ER-2 Maintenance
Dan Heckel	ER-2 Maintenance - Mechanic	Mike S. Kapitzke	ER-2 Engineering
Dave Sermon	ER-2 Life Support	Monte Cook	ER-2 Maintenance - Electrician
David Thompson	AVIRIS Level 2 Algorithm	Pat Lloyd	ER-2 Maintenance - Crew Chief
David Van Gilst	Payload Systems Engineer	Patrick Grant	MASTER Engineer
Denis Steele	ER-2 Pilot	Paul Everheart	ER-2 Maintenance - Crew Chief
Dennis Gearhart	MASTER Instrument Technician	Raul Cortes	ER-2 Life Support
Donald "Stu" Broce	ER-2 Pilot	Rich Weller	ER-2 Maintenance
Edward "Ted" Hildum	MASTER Engineer	Robert Billings	MASTER Data Analyst/Technician
Eric Buzay	Payload Systems Engineer	Robert O. Green	AVIRIS Experiment Scientist
Eric Fraim	MASTER Data Analyst	Rose Dominguez	MASTER Lead Data Analyst/Coordinator
Eric Stith	Payload Systems Engineer	Ryan Ragsdale	ER-2 Life Support
Gerardo Rivera	MASTER Data Processing	Sarah Lundeen	AVIRIS Data System Lead
Glynn Hulley	MASTER Level 2 Algorithms	Scott Nolte	AVIRIS Technician and Calibration
Howard "Dean" Neeley	ER-2 Pilot	Simon Hook	MASTER Experiment Scientist
Ian McCubbin	HyspIRI Mission Manager	Steve Johnson	ER-2 Maintenance - Mechanic
Jeff Myers	MASTER Instrument Lead	Tim Moes	ER-2 Project Manager
Jerry Roth	ER-2 Maintenance - Mechanic	Tim Williams	ER-2 Pilot
Johnny Bryant	ER-2 Maintenance - Electrician	Tom Ellis	MASTER Calibration Engineer
Joseph Boardman	AVIRIS Orthorectification	Wason Miles	ER-2 Life Support
Josh Graham	ER-2 Life Support	Wendy Given	ER-2 Maintenance - Logistics
Kent Dunwoody	MASTER Instrument Technician	Woody Turner	HyspIRI Progam Manager
Kevin Kraft	ER-2 Maintenance - Logistics	Yasha Mouradi	AVIRIS Data Processing Academic Part Time

FlightAware LIVE FLIGHT TRACKING

Join FlightAware (Why Join?) Login English (USA)

- Live Flight Tracking
- Pilot Resources
- Aviation Photos
- Squawks & Headlines
- Discussions
- Commercial Services
- About FlightAware
- Contact

LIVE FLIGHT TRACKER

PRIVATE FLIGHT TRACKER:

Flight/Tail# NASA806

TRACK FLIGHT

AIRLINE FLIGHT TRACKER:

Airline e.g. United

Flight # e.g. 450

TRACK FLIGHT

FORGOT THE FLIGHT NUMBER?

AIRPORT TRACKER/INFO

Airport Code KPMD

-or-

Airport City e.g. New York

VIEW ACTIVITY

VIEW INFO

Live Flight Tracker ✈ NASA806

NASA806

National Aeronautics And Space Administration

Palmdale Regional (KPMD – info) Palmdale Re

Palmdale, CA Pa

10:27AM PDT 12:1

Scheduled: 09:30AM PDT Schedule

Other flights between these airports

Duration: 1 hour 50 minutes

Wednesday, June 4, 2014

Status	*result unknown* (?) (track log & graph)
Aircraft	Lockheed ER-2 (single-jet) (U2/I – phot
Speed	Filed: 402 kts (graph)
Altitude	Filed: 65,000 feet (graph)
Distance	Direct: 0 sm Planned: 1,383 sm
Route	GVO197044 RZS ROSIE (Decode)

Get notified of th

ACTIVITY LOG

Want a full history search for NASA806 dating back to 1998? Buy no

Date	Aircraft	Origin	Destination	Departure	Arrival
04-Jun-2014	U2/I	Palmdale Regional (KPMD)	Palmdale Regional (KPMD)	10:27AM PDT	*12:17PM PDT (?)*
03-Jun-2014	U2/I	Palmdale Regional (KPMD)	Palmdale Regional (KPMD)	09:52AM PDT	03:46PM PDT

Questions?